



Distinguishability of Particles in Glass-Forming Systems

Mauro, John C.; Smedskjær, Morten Mattrup

Publication date:
2015

Document Version
Early version, also known as pre-print

[Link to publication from Aalborg University](#)

Citation for published version (APA):

Mauro, J. C., & Smedskjær, M. M. (2015). *Distinguishability of Particles in Glass-Forming Systems*. Abstract from ACerS GOMD-DGG Joint Annual Meeting, Miami, United States. <http://ceramics.org/meetings/glass-optical-materials-division-and-deutsche-glastechnische-gesellschaft-joint-annual-meeting-2015>

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal -

Take down policy

If you believe that this document breaches copyright please contact us at vbn@aub.aau.dk providing details, and we will remove access to the work immediately and investigate your claim.

Distinguishability of Particles in Glass-Forming Systems

John C. Mauro¹, Morten M. Smedskjaer²

¹ *Science and Technology Division, Corning Incorporated, Corning, USA*

² *Section of Chemistry, Aalborg University, Aalborg, Denmark*

The distinguishability of particles has important implications for calculating the partition function in statistical mechanics. While there are standard formulations for systems of identical particles that are either fully distinguishable or fully indistinguishable, many realistic systems do not fall into either of these limiting cases. In particular, the glass transition involves a continuous transition from an ergodic liquid system of indistinguishable particles to a nonergodic glassy system where the particles become distinguishable. While the question of partial distinguishability of microstates has been treated previously in quantum information theory, this issue has not yet been addressed for a system of classical particles. We present a general formalism for quantifying particle distinguishability in classical systems. Example calculations for a simple glass-forming system demonstrate the continuous onset of distinguishability as temperature is lowered. We also examine the loss of distinguishability in the limit of long observation time, coinciding with the restoration of ergodicity. We discuss some of the general implications of our work, including the direct connection to topological constraint theory of glass. We also discuss qualitative features of distinguishability as they relate to the Second and Third Laws of thermodynamics.